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AUTHOR Johnson, Jean
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ABSTRACT

A study was conducted to examine the effects on young women of reading about nontraditional role models in the sciences and engineering, and discussing various aspects of participating in science and engineering careers with a trained instructor. Subjects for the study were 153 female students enrolled in advanced, elective science courses (10th through 12th grade) at a suburban high school in the Phoenix, Arizona metropolitan area. All participants had completed two to seven semesters of study in both mathematics and science, nearly all planned to pursue a college undergraduate degree, and many aspired to do graduate work. Their attitudes toward careers were expected to become more positive with regard to appropriateness for both men and women; their level of interest; and confidence in their ability to be successful. The subjects were also expected to be able to generalize to careers that were not included in the experiment. In general, findings indicated that: a significant positive change in confidence occurred in the experimental group across all eight careers surveyed in the posttest phase; the generalization effect did take place; young women's attitudes toward the appropriateness of careers for both sexes were not modified; and there was no significant difference between experimental and control groups in terms of increased interest in careers. Some factors to be considered in future studies of this nature are suggested. (25 references) (CGD)

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Author:

Jean Johnson

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Effects of Successful Female Role Models on Young Women's Attitudes Toward Traditionally Male Careers

Jean Johnson
Division of Psychology in Education
Arizona State University

Paper presented at the annual conference of the
Association for Educational Communications and Technology
Dallas, February 1989

Introduction

Despite their increasing numbers in the work force, women continue to be concentrated in only 20 of the 440 occupational classifications listed by the Department of Labor. Almost 80 percent of working women remain in low-paying, low-skilled jobs with limited opportunities for advancement. In 1983, only 3.4 percent of the engineers and 25.6 percent of the scientists were women (U.S. Bureau of the Census, 1986).

Cultural sex stereotyping is a major factor in guiding women in their career choices. Shinar (1975) asserts that sexual stereotypes of occupations are clearly defined and agreed upon by both females and males. Both groups express greater interest in careers traditional for their own sex (Gregg & Dobson, 1980). In her review of studies of occupational stereotypes, Gottfredson (1981) found that people's perceptions of occupations were similar regardless of their sex, age, social class, educational level, or ethnic group. Compatibility of a career with one's self-concept is influenced by the sextype of the job.

A great deal of human behavior is developed through modeling. New patterns of behavior can be acquired through vicarious experience -- observing others perform successfully (Bandura, 1977). Investigators have used positive role models to change student attitudes toward careers not traditional for their sex. Greene, Sullivan, and Beyard-Tyler (1982) and Savenye (1983) provided subjects with exposure in written or slide form to role models successful in nontraditional careers. Results of the two studies showed significant positive change in student attitudes about the appropriateness of careers not tradtional for each sex. Angrist and Almquist (1975) found that women who chose nontraditional careers were twice as likely as women who chose traditional careers to state that occupational role models were the major factor influencing their choice.

Exposure to sex-equitable materials results in more flexible attitudes about sex roles. Schau and Scott (1984) reached that conclusion from their review of the literature. Ashby and Wittmaier (1978) found that fourth-grade girls who heard stories about women in nontraditional occupations rated traditionally male jobs and personal characteristics as more appropriate for females than did girls who heard stories about women in traditional occupations.

Active participation in a treatment group can have a persuasive impact. In their review of research, Fleming and Levie (1978) found that subjects who participated in role-playing or in group discussions about an issue demonstrated greater attitude changes than those who were simply given information.

Belief in one's ability to succeed is a major factor in career choice. Females reported significantly greater confidence in their ability to

perform traditionally female jobs than traditionally male jobs (Betz & Hackett, 1981). McMahan (1982) found that college females had lower expectations for success in cognitive tasks in general than did college males and that they rated their performance to be lower than did males. Junior- and senior-high females (Rosen & Aneshensel, 1978) reported lower expectations with regard to their academic achievement than did males. Fennema and Sherman (1978) report that as early as the sixth grade, girls express less confidence than boys in their ability to do mathematics. In high school they perceive mathematics as being less useful to them. Differences between females and males in motivation and achievement in science are small, but consistent, and favor males (Steinkamp & Maehr, 1984).

Two career areas that offer challenge, high pay, prestige, and opportunity for professional growth are science and engineering. Females from elementary school through high school believe that science is a career for themselves as well as for boys (Steinkamp & Maehr, 1984). However, Ware, Steckler, and Leserman (1985) found that women at the college level report less enjoyment of their science courses than males and abandon their interest in a science career at greater rates than men. Among explanations offered for women's failure to pursue science and mathematics careers are traditional sex-role behavior and their perceptions of their abilities.

The purpose of this study was to examine the effects on young women of reading about nontraditional role models in the sciences and engineering, and discussing with a trained instructor various aspects of participating in science and engineering careers. The dependent variables studied were (1) appropriateness of the careers for both women and men, (2) expressed interest in the careers, and (3) subjects' belief in their ability to succeed in the careers. There were two treatment conditions (experimental vs. control) and two evaluation conditions (pretest vs. posttest). To test for a possible generalization effect, subjects' attitudes were assessed both on careers included in the treatment and on a sample of careers not included in the treatment. A Career Survey developed from instruments devised by Greene et al. (1982) and Betz and Hackett (1981) was used to measure student attitude. It was predicted that attitudes of the experimental group would become more positive toward the careers included in the treatment. It was further expected that the positive attitude change would generalize to the second set of science and engineering careers not presented during the experimental instruction.

Method

Subjects

Subjects for the study were 153 tenth-, eleventh-, and twelfth-grade female students enrolled in advanced, elective science classes (chemistry, qualitative and organic chemistry, physics, and advanced biology) at a suburban high school in the Phoenix metropolitan area. There were 73 students in the experimental group and 80 in the control group. All female students in advanced, elective classes were included except for those few in one class that met at a time when no other subjects were available. Subjects had completed from two to seven semesters of study in both mathematics and science. Responses to a question regarding careers being considered indicated that nearly all planned to pursue a college undergraduate degree and many planned advanced study.

Materials

Experimental materials prepared for the study consisted of an instructor guide and the following instructional materials: (1) overhead transparencies presenting facts on women in the world of work, (2) descriptions averaging 747 words in length portraying the career and lifestyle of four women in traditionally male jobs, and (3) discussion questions.

Careers selected for the study were professional jobs that require a background in science and/or mathematics and in which at least 70 percent of those currently employed are male. To appeal to a broad range of interests, two each were selected from engineering, physical sciences, life sciences, and health diagnosing practices. One of the two careers from each occupational group, or a total of four in all, was presented to the subjects in the experimental group. The careers are listed below.

Occupational Area	Careers Presented	Careers Not Presented
engineering	industrial engineer	biomedical engineer
physical sciences	petroleum geologist	food chemist
life sciences	forester	fish and wildlife biologist
health diagnosing practices	optometrist	veterinarian

The job descriptions for the careers presented information obtained in interviews conducted by the author with women in traditionally male jobs. Standard content in job descriptions in the Occupational Outlook Handbook (U.S. Bureau of Labor Statistics, 1984) provided the basis for the interview questions: nature of the work, working conditions, educational and training requirements, earnings and other rewards, and employment outlook. Other information in the career descriptions included the role model's reason(s) for her career choice, her lifestyle, and advice to high school students regarding career search.

The instructor guide followed accepted instructional design practices as described by Gagne and Briggs (1979). It provided the instructor with the objectives of the program, an overview of the program to present to the subjects, a motivating activity (facts about women in the world of work), guidance in the presentation of career information, and discussion questions and suggestions on how to relate the information to the target audience and to enhance generalization of the information.

The overview and motivating activity included data on numbers of working women, average years in the work force, percentages of working women by marital status and with children, increasing percentages of women in traditionally male careers, and weekly salaries in relation to the percentage of women in the job. Statistical information was obtained from the U.S. Bureau of the Census (1984a, 1984b) and the U.S. Department of Labor (1984).

The discussion questions were designed with two purposes in mind. The first was to relate skills already possessed by the students to those important in the careers. The second was to encourage discussion of solutions to potential problems encountered in entering the career.

Criterion Measure

The Career Survey was constructed to measure subjects' beliefs about the appropriateness of the careers for both women and men, their interest, and their confidence that they could succeed in the eight careers. Each of the eight pages listed a single career with a brief description of its major responsibilities and three questions to be answered. The descriptions were included so that both experimental and control groups would share common knowledge about the basic job responsibilities. All eight careers were included in the pre- and posttests for both the experimental and control groups. A sample set of items for one occupation, biomedical engineer, from the Career Survey follows. The three attitude questions were the same for all eight occupations.

BIOMEDICAL ENGINEER

- Helps to design and develop new equipment and methods for doctors to use in surgery or in the detection and diagnosis of disease
- Works to improve equipment such as heart valves and kidney machines
- Designs equipment to monitor patients
- Does research with doctors to understand how drugs affect people

Answer these items:

Answer item (1) by marking an 'X' in the blank next to the word(s) which you think best completes the question:

1. Do you think this career is appropriate for

men _____ women _____ both men and women _____

For items 2 and 3, circle the number of the response which best describes your thinking:

2. How interested are you in this career?

not at all interested		somewhat interested		very interested
1	2	3	4	5

3. How confident are you that you could be successful in this career?

not at all confident		somewhat confident		very confident
1	2	3	4	5

Procedures

Teachers of the science classes included in the study administered the pretest to their students (both female and male) three weeks prior to the treatment. Males were included in order to not draw attention to the intervention. Only the responses of the female students were analyzed. A female graduate student with several years' experience in high school teaching was trained as the experimenter.

The study was conducted during regularly scheduled classes on two consecutive days. Female students were blocked by class and then randomly assigned to the treatment or control group.

The experimental treatment consisted of the following:

Day 1: (1) Presentation of statistics on women at work.
(2) Reading of two career descriptions, with each followed by the discussion of questions relating to personal skills required in performing the job and to solving problems on the job.

Day 2: (1) Reading and discussion of the remaining two career descriptions.
(2) Discussion of general questions: the effect of sexual stereotypes on thinking about a career; some of the barriers and/or problems in entering a career typically followed by men; and how to overcome or solve the above.
(3) Posttest.

Subjects in the control group (and male students) were administered the posttest during their regular class time on Day 2 of the intervention with the experimental group.

Design and Data Analysis

A 2 (experimental vs. control) x 2 (pretest vs. posttest) x 8 (careers) factorial design with three dependent variables was used. A multivariate analysis of variance (MANOVA) was performed to determine whether females' attitudes toward traditionally male careers changed as a result of

treatment, and whether those attitudes generalized to careers not included in the treatment. Univariate analysis of variance (ANOVA) data for each dependent variable are reported when the overall MANOVA and the univariate effects are both at or beyond the .05 level of probability.

Results

The means and standard deviations of scores obtained for each of the three dependent variables for each of the eight jobs by treatment condition are shown in Table 1. Item responses for appropriateness were obtained on a three-point scale with "men" as (1), "women" as (2), and "both men and women" as (3). The goal of the study entailed assessing the degree of change from a stereotypic male-oriented view of the careers. As such, the change from a male orientation to either a female or androgynous view represents the construct under study. Item responses for interest and confidence were obtained on a five-point scale ranging from "not at all" (1) to "very" (5) for both interest and confidence.

The data were submitted to a 2 (treatment conditions) x 2 (testing conditions) x 8 (careers) mixed multivariate analysis of variance (MANOVA) procedure. This analysis assesses significant differences due to the between-groups factor (treatment condition), the two within-groups factors (testing sessions and job), and the interaction of these on effects.

Multivariate and univariate analysis of variance results are presented in Table 2. Results are reported for main effects, two-way interactions, and the three-way interaction effects.

Main Effects

Multivariate analysis of variance for group revealed nonsignificant differences between the experimental and control groups. Consequently, univariate analyses were not explored. The two group pretests were similar.

Both MANOVA and ANOVA results showed significant differences due to testing session. Multivariate analysis revealed an overall difference (Λ = .34219, F (3, 127) = 81.378, $p < .001$. Univariate analyses revealed differences on all three dependent variables: F (1, 129) = 182.737, $p < .001$ for appropriateness; F (1, 129) = 116.621, $p < .001$ for interest; and F (1, 129) = 14.476, $p < .001$ for confidence. Subjects typically scored higher on the posttest than on the pretest. This is a common result, probably due to familiarity with the instrument as a consequence of the pretest session.

Multivariate analysis for job showed significant differences as well, (Λ = .73972), F (21, 2588) = 13.641, $p < .001$. Results from univariate analyses were also significant: for appropriateness, F (7, 903) = 26.606, $p < .001$; for interest, F (7, 903) = 15.567, $p < .001$; and for confidence,

F (7, 903) = 28.007, $p < .001$. This indicates some careers were perceived as more appealing than others.

Two-way Interactions

The multivariate analysis of variance performed on the group by test interaction revealed a significant difference showing that the experimental group experienced greater positive change than the control group, (Λ = .93413), F (3, 127) = 2.985, $p < .05$. Univariate analyses for the dependent variables appropriateness and interest showed no significant differences ($p > .05$), but the univariate analysis for confidence was significant, F (1, 129) = 5.557, $p < .05$. While both groups showed gain from pretest to posttest, the experimental group had a significantly larger gain in confidence in being successful in the jobs.

No significant difference was found in the multivariate analysis of the group by job interaction. Both groups held similar views of the jobs being tested.

The test by job interaction revealed significance in both the multivariate and univariate cases. The multivariate analysis yielded a large difference, (Λ = .84521), F (21, 2588) = 7.432, $p < .001$. Univariate analyses resulted in F (7, 903) = 12.234, $p < .001$ for appropriateness; F (7, 903) = 11.254, $p < .001$ for interest; and F (7, 903) = 6.837, $p < .001$ for confidence. This indicates that both groups perceived the careers more positively on the posttest.

Three-way Interaction

The group by test by job MANOVA result showed a nonsignificant interaction. Consequently, univariate analyses were not explored. Changes within the experimental and control groups were found to be unrelated to job.

Discussion

In this study, tenth-, eleventh-, and twelfth-grade female students from advanced, elective science courses read about and discussed successful women in traditionally male careers. It was predicted that their attitudes toward careers with regard to (1) appropriateness for both women and men, (2) interest, and (3) confidence in their ability to be successful would become more positive. It was also expected that those positive attitudes would generalize to careers that were not presented. Results showed that for the experimental group there was a significant positive change in confidence across all eight careers surveyed on the posttest, both those that had been presented in the intervention and those that had not.

The generalization effect did take place. There were no significant differences for the variables appropriateness and interest.

The intervention was not effective in changing young women's attitudes with regard to the appropriateness of the careers for both women and men. However, the data suggest that there was a ceiling effect that had not been observed in earlier, related research. The highest score possible on this measure, 3.000, was evidenced on 10 of the 32 items. This indicates that the instrument was not sensitive enough to adequately measure the full range of student attitudes. The high scores throughout raise the question of the efficacy of intervening with this relatively sophisticated population. The young women in the study may have benefitted from societal changes of the past few years.

Though interest in the careers did increase somewhat, the difference between the groups was not significant. Treatments of one to five class periods in length have not demonstrated effectiveness in increasing students' interest in careers not traditional for their sex (Brooks, Holahan, & Galligan, 1985; Savenye, 1985). Apparently, more powerful and longer-lasting interventions are required. Perhaps it is necessary to help students determine their interests and skills and relate these to career opportunities and job responsibilities.

Appropriateness, interest, and confidence are clearly related, but the nature and extent of the relationship are not understood. Perhaps greater increase in interest follows successful experience and increase in confidence. Higher self-efficacy expectations may broaden or reopen occupational areas that previously had been judged inappropriate. Ginzberg, Ginsburg, Azelrad, and Herma (1951) reported that adolescent males had great difficulty identifying their interests and aptitudes. They hoped to discover their interests and abilities through college or work experience.

The significant positive change in confidence among subjects in the experimental group supports Bandura's (1977) theory that vicarious experience (here, reading about a successful role model) increases self-efficacy. Angrist and Almquist (1975) and Auster and Auster (1981) report on the importance of exposure to, and support of, role models in young women's nontraditonal career choices. The generalization effect suggests that the present intervention can be useful with a variety of jobs.

There are three important factors to consider in future studies. One is to work with a younger, less sophisticated group that will have no ceiling effect. Additionally, a younger group may be more persuasible (Fleming & Levie, 1978). Another factor is to work with intact classes in which students have had time to become comfortable with each other. It may be necessary to provide time to develop rapport between the experimenter and the group and among members of the group if it is desired that the subjects participate in a discussion. A third factor is to understand what qualities

and/or values females attribute to particular jobs and what job characteristics are important to them. Careers can be analyzed and presented in terms of the attributes and responsibilities that may appeal to females.

Perhaps it is true, as Gottfredson (1981) suggests, that by adolescence, occupational choices have been limited to what is perceived as appropriate for one's own sex. A variety of activities -- including hands-on experience, observing and talking with role models, site visits, assessment of interests and abilities, and a relating of skills and valuesto job responsibilities -- may be required on an ongoing basis to promote positive and stable attitudes toward the full range of occupational opportunities available today.

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Table 1
Descriptive Statistics Regarding
Attitudes Toward Nontraditional Careers by Treatment Condition

	Experimental (N=63)				Control (N=68)			
	Pretest		Posttest		Pretest		Posttest	
Careers	M	SD	M	SD	M	SD	M	SD
industrial engineer								
appropriateness	2.714	.705	3.000	.000	2.588	.815	2.868	.486
interest	1.571	.856	1.905	1.043	1.765	.948	2.088	1.116
confidence	2.222	1.170	2.762	1.341	2.500	1.153	2.794	1.264
food chemist								
appropriateness	3.000	.000	3.000	.000	2.956	.270	2.926	.315
interest	1.714	.941	1.762	.979	2.132	1.064	2.132	1.105
confidence	2.254	1.092	2.683	1.242	2.750	1.084	2.912	1.278
petroleum geologist								
appropriateness	2.810	.592	2.968	.252	2.838	.536	2.750	.655
interest	1.651	.970	1.730	1.019	1.868	1.050	1.779	.928
confidence	2.222	1.128	2.524	1.216	2.515	1.240	2.618	1.222
fish & wildlife biologist								
appropriateness	3.000	.000	3.000	.000	3.000	.000	2.912	.376
interest	2.365	1.182	2.571	1.353	2.485	1.275	2.794	1.166
confidence	3.000	1.218	3.328	1.388	3.074	1.176	2.618	1.176

Note. Item responses for appropriateness were obtained on a 3-point scale with "men" as (1), "women" as (2), and "both men and women" as (3). Item responses for interest and confidence were obtained on a 5-point scale ranging from "not at all" (1) to "very" (5) interested and confident.

Table 1 (continued)

Careers	Experimental (N=63) Pretest M	Experimental (N=63) Pretest SD	Experimental (N=63) Posttest M	Experimental (N=63) Posttest SD	Control (N=68) Pretest M	Control (N=68) Pretest SD	Control (N=68) Posttest M	Control (N=68) Posttest SD
optometrist								
appropriateness	2.984	.126	3.000	.000	2.971	.243	2.971	.170
interest	2.397	1.225	2.651	1.285	2.235	1.148	2.721	1.118
confidence	2.904	1.254	3.270	1.139	3.118	1.166	3.368	1.145
biomedical engineer								
appropriateness	2.921	.373	3.000	.000	2.824	.571	2.882	.441
interest	2.175	1.302	2.206	1.138	2.235	1.198	2.662	1.288
confidence	2.413	1.291	2.794	1.246	2.618	1.339	3.176	1.257
forester								
appropriateness	2.873	.492	2.968	.252	2.765	.649	2.824	.571
interest	1.698	.891	2.143	1.148	1.647	.927	2.088	1.156
confidence	2.413	1.253	2.889	1.271	2.574	1.213	2.809	1.385
veterinarian								
appropriateness	3.000	.000	3.000	.000	2.956	.270	2.971	.170
interest	2.857	1.318	3.063	1.243	2.588	1.318	3.044	1.251
confidence	3.127	1.350	3.381	1.288	3.162	1.288	3.456	1.321

Table 2
Multivariate and Univariate ANOVA Source Table
for Appropriateness, Interest, and Confidence

Source of Variance	Multivariate Wilk's Lambda	df	F	p	Univariate df	F	p
main effects							
group	.98853	3, 127	.491	ns			
appropriateness					1, 129	.016	ns
interest					1, 129	1.055	ns
confidence					1, 129	.611	ns
test	.34219	3, 127	81.378	.001			
appropriateness					1, 129	182.737	.001
interest					1, 129	116.621	.001
confidence					1, 129	14.476	.001
career	.73972	21, 2588	13.641	.001			
appropriateness					7, 903	26.606	.001
interest					7, 903	15.567	.001
confidence					7, 903	28.007	.001

Table 2 (continued)

Source of Variance	Multivariate Wilk's Lambda	df	F	p	Univariate df	F	p
two-way interactions							
group by test	.93413	3, 127	2.985	.05			
appropriateness					1, 129	.966	ns
interest					1, 129	.067	ns
confidence					1, 129	5.557	.05
group by career	.97096	21, 2588	1.271	ns			
appropriateness					7, 903	1.490	ns
interest					7, 903	.608	ns
confidence					7, 903	1.196	ns
test by career	.84521	21, 2588	7.432	.001			
appropriateness					7, 903	12.243	.001
interest					7, 903	11.254	.001
confidence					7, 903	6.837	.001
three-way interaction							
group by test by career	.98188	21, 2588	.787	ns			
appropriateness					7, 903	1.627	ns
interest					7, 903	.934	ns
confidence					7, 903	.508	ns